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REMARKS

The application identified above has been amended in response to the Office Action dated February 13, 2004. Claims 1, 2-4, 9, 11, 13-21, 24, 26 and 32 have respectively been amended, and Claim 34-37 have been added, to further emphasize patentably distinguishing features of the invention, as well as to provide Applicants with the full scope of protection to which they deem their invention entitled. Claims 5-8, 10, 12, 22-23, 27 and 31 remain in their respective original forms. Claims 25 and 28-30 have been canceled. Claim 33 has been withdrawn.

Each of the independent Claims 1, 4, 14 and 19 has more particularly been amended to incorporate subject matter previously recited by original Claim 9.

Claim 3 has been amended to recite the feature of the ion-ion plasma having positive and negative charge densities that are substantially equal. This feature is disclosed in the application, such as at page 11, lines 18-22.

Claim 9 and 13 have been amended to recite features disclosed by original Claim 4, Claim 18 has been amended to recite a feature disclosed by original Claim 14, and Claim 20 has been amended to recite a feature disclosed by original Claim 19.

Claims 2, 11, 15-17, 21, 24, 26 and 32 have respectively been amended to read with enhanced clarity and definiteness.

Added Claims 35-37 respectively depend from independent Claim 31.

Claim 33 was withdrawn in view of its non-election following a requirement for restriction.

In the Office Action, the Examiner allowed Claims 31 and 32. Applicants, through their Attorney, express appreciation to the Examiner for this action. New Claims 34-37 respectively depend from allowed Claim 31, and are thus considered to be allowable.

In the Office Action, the Examiner rejected Applicants' Claims 1 and 3 under 35 USC §102(b), as being anticipated by U.S. Patent No. 6,335,535, to Miyake et al. The Examiner rejected Claims 2 and 4-30 under 35 USC §103(a) as being obvious in view of Miyake alone, or in combination with U.S. Patent No. 6,436,304 to Nogami et al. and/or U.S. Patent No. 5,744,011 to Okubo et al.

Claims 2 and 15 were also rejected under 35 USC §112, second paragraph. Applicants consider that this rejection has now been overcome by amendments made to Claims 2 and 15 herein.

As emphasized in the application, such as at page 6, lines 8-11, Applicants in making their invention sought to produce a method for alternately bombarding a substrate by both positive ions and negative ions, such that the charges of the ions balance, and significant charge buildup on the substrate is avoided. Applicants recognized that a method of this type could provide numerous benefits and advantages, such as those listed in the application at page 6, lines 17-27. Applicants further recognized that these benefits and advantages could be achieved by the method of Claim 1, as now amended. Claim 1 now recites a method for plasma processing, comprising the steps of (1) generating a substantially electron-free ion-

ion plasma in proximity to at least one substrate, and (2) applying a bias signal having signal components of alternating positive and negative polarities to the substrate, at times when the ion-ion plasma is present, to induce bombardment of the substrate by both positive and negative ions.

Applicants' specification discloses numerous embodiments of the Claim 1 method, and particularly the feature of applying a bias signal having components of alternating positive and negative polarities to the substrate. This feature is clearly disclosed in Applicants' original Claim 9. This feature is further disclosed by each of the FIGS. 2, 3 and 5-9, of Applicants' drawings, and by portions of Applicants' specification respectively corresponding thereto.

It is well established that the entire teaching of each prior art reference must be considered in its entirety. **MPEP 2141.02** Applying this basic principle to Miyake, it is seen that the Miyake et al. reference states repeatedly that its teachings are intended to implant negative ions only into a substrate. This object of Miyake is set forth in the abstract thereof, in its Claim 1, and throughout the Miyake specification. At col. 7, lines 66-67, Miyake states expressly that, "In the present invention, negative hydrogen ions H^- are employed in place of positive ions" (Emphasis added). Thus Miyake, in seeking to substitute negative ions for positive ions, clearly and explicitly teaches away from Applicants' Claim 1 recitation of bombardment of the substrate by both negative and positive ions.

In order to implement its purpose of employing negative ions rather than positive ions, the Miyake arrangement must apply only positive bias to the substrate, as repeatedly

emphasized such as at col. 8, lines 13-16, col. 11, lines 13-15 and col. 14, lines 50-56, as well as at FIG. 3B of the Miyake drawings. FIG. 3B clearly teaches that the bias signal applied to a substrate in Miyake is either positive or is switched off. Thus, Miyake further teaches away from the recitation of Applicants' Claim 1, and in particular from the Claim 1 step of applying a bias signal having components of alternating positive and negative polarities to the substrate.

The positive bias taught by FIG. 3B of Miyake is achieved by the arrangement shown in FIG. 2 thereof, and described at col. 12, lines 14-27. More specifically, FIG. 2 shows a substrate 58 mounted on a flat electrode 31 and a shaft 33. As expressly stated at col. 12, lines 14-17, these components are connected to the positive electrode of a positive bias power source 44, through a second switch 43. The switch 43 is periodically switched on and off by second trigger circuit 46, to provide the positive bias waveform shown by FIG. 3B. Thus, the substrate 58 of Miyake can receive only a positive bias or no bias. However, the Miyake arrangement, and particularly positive bias power source 44 thereof, will not apply a bias signal having a component of negative polarity, as required by Applicants' Claim 1.

It is stated in the Office Action, on page 4, that fig. 2 of Miyake shows an AC source connected to the substrate holder and controlled by circuit 46. Applicants consider that the source referred to in this statement can only be power source 44. Accordingly, with all due respect, Applicants do not understand this statement in the Office Action.

In the view of Applicants, those of skill in the art readily understand that the term “AC” is an abbreviation for “alternating current,” that is, an electric current that reverses its direction at regular intervals. To support this view of Applicants, Exhibit A, which is an excerpt from Merriam-Webster’s Collegiate Dictionary, Tenth Edition copyright 2002, is attached hereto. Exhibit A includes copies of the cover page, and of a page defining alternating current and its abbreviation AC.

As is further well known by those of skill in the art, polarity of a signal is determined by the direction of associated current flow. Accordingly, if current direction regularly changes or alternates, signal polarity must likewise alternate between being positive and negative. Clearly, positive bias power source 44 of Miyake cannot provide a signal having a negative component. Moreover, the symbol shown for power source 44 in FIG. 2 of Miyake is the well known conventional symbol used to represent a battery or other direct current source. Such a source has clearly defined positive and negative electrodes, and Miyake expressly teaches, at col. 12, lines 14-17, that the substrate thereof is connected to the positive electrode of positive bias source 44. These teachings of Miyake emphasize even further that a signal component of negative polarity cannot be applied to the substrate by positive source 44.

The Nogami and Okubo references were each cited to show certain limited features. Neither of these references, either alone or in any combination with one another or the Miyake patent, is considered to overcome the deficiencies of Miyake discussed above in connection with Applicants’ Claim 1.

Claims 2 and 3 respectively depend from Claim 1, and are each considered to patentably distinguish over the art for the same reasons given in support thereof.

In addition, Claim 2 is considered to distinguish over the art in reciting plasma generated in a chamber containing a gas phase having high net electron affinity. Applicants consider that this feature is not shown or suggested by the prior art. While Okubo discloses use of a gas exhibiting affinity for electrons in connection with plasma formation, Okubo does not teach use of pulsed power to form plasma, as does Miyake. However, the nature of negative ion formation in a continuous power plasma is markedly different from a pulsed power plasma arrangement. One modestly skilled in the art of plasma sheath theory will appreciate that negative ions and cold electrons are confined to the plasma bulk and hence do not have a surface loss mechanism. However, in pulsed power plasmas, negative ions and cold electrons can diffuse as the sheath collapses in the afterglow, and hence have a different loss mechanism in addition to the bulk loss mechanisms. Accordingly, a person of skill in the art would be led away from combining teachings of Okubo with teachings of Miyake in order to realize the recitation of Applicants' Claim 2.

Claim 3 is considered to further distinguish over the art in reciting an ion-ion plasma having positive and negative charge densities that are substantially equal. None of the cited art or any combination thereof is considered to show or suggest this feature.

Independent Claims 4, 14 and 19 respectively incorporate subject matter similar to subject matter of Claim 1, and are thus considered to patentably distinguish over the prior art for the same reasons given in support thereof.

Claims 5-13 respectively depend from Claim 4 and are each considered to patentably distinguish over the prior art for the same reasons given in support thereof.

Claims 15-18 respectively depend from Claim 14, and are each considered to patentably distinguish over the prior art for the same reasons given in support thereof.

Claim 20-24 and 26-27 respectively depend from Claim 19, and are each considered to patentably distinguish over the prior art for the same reasons given in support thereof.

In addition, Claims 13, 18 and 20 are each considered to distinguish over the art in reciting a specified fractional value for embodiments of Applicants' invention. Applicants consider that this value is not shown or suggested by the prior art.

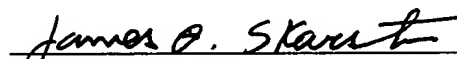
CONCLUSION

In light of the arguments set forth above, Applicants respectfully submit that the application is now in allowable form. Accordingly, Applicants respectfully request consideration and allowance of the currently pending claims.

It is believed that no additional fees are due at this time. If this is incorrect, Applicants hereby authorize the Commissioner to charge any fees, other than the issue fee, that may be required by this paper to our Deposit Account No. 07-0153. The Examiner is respectfully requested to call Applicants' Attorney for any reason that would advance the current application to issue. Please reference Attorney Docket No. 119941-1089.

Dated: May 13, 2004.

Respectfully submitted,
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34 alpine • aluminium

al-pine 'al-pīn\ n (ca. 1828) 1: a plant native to alpine or boreal regions that is often grown for ornament 2 *cap*: a person possessing Alpine physical characteristics

Alpine adj (15c) 1 *often not cap*: of, relating to, or growing in the Alps or any mountains 2 *often not cap*: of, relating to, or growing in the biogeographic zone including the elevated slopes above timberline 3: of or relating to a physical type characterized by a broad head, stockiness, medium height, and brown hair or eyes often regarded as constituting a branch of the Caucasian race 4: of or relating to competitive ski events consisting of slalom and downhill racing — compare **NORDIC**

al-pin-ism 'al-pīn-iz-m\ n, *often cap* (1884): mountain climbing in the Alps or other high mountains — **al-pin-ist** 'al-pīn-ist\ n

al-ready 'ol-tē-de, 'ol-adv [ME *al ready*, fr. *al* *ready*, adj., wholly ready, fr. *al* all + *redy* ready] (14c) 1: prior to a specified or implied past, present, or future time: by this time: PREVIOUSLY (he had ~ left when I called) 2 — used as an intensive (all right ~) (enough ~)

al-right 'ol-rit, 'ol-adv or adj (1887): ALL RIGHT *usage*: The one-word spelling *alright* appeared some 75 years after *alright* itself had reappeared from a 400-year-long absence. Since the early 20th century some critics have insisted *alright* is wrong, but it has its defenders and its users. It is less frequent than *all right* but remains in common use esp. in journalistic and business publications. It is quite common in fictional dialogue, and is used *occas.* in other writing (the first two years of medical school were *alright* — Gertrude Stein)

Al-sa-tian 'al-sā-shən\ n [ML *Alsacia* Alsace] (1917): GERMAN SHEPHERD

al-sike 'al-sik\ n [Alsike, Sweden] (1852): a European perennial clover (*Trifolium hybridum*) much used as a forage plant

al-so 'ol(s)-sō, 'ol-adv [ME *al so*, fr. OE *eallswā*, fr. *eall* all + *swā* so — more at *so*] (bef. 12c) 1: LIKEWISE 1: 2: in addition: BESIDES, TOO **al-so-ran** 'al-sō-ran\ n (1896) 1: a horse or dog that finishes out of the money in a race 2: a contestant that does not win 3: one that is of little importance esp. competitively (was just an ~ in the scramble for privileges — C. A. Buss)

Al-tai 'al-tā-ik\ adj (ca. 1828) 1: of or relating to the Altai Mountains 2: of, relating to, or constituting the Turkic, Tungusic, and Mongolian language families collectively

Al-tair 'al-tā-ir, 'al-ter, 'al- n [Ar *al-tā-ir*, lit., the fiercer] the brightest star in the constellation Aquila

al-tar 'ol-tār\ n, *often attrib* [ME *alter*, fr. OE *altar*, fr. L *altare*; prob. akin to L *adolere* to burn up] (bef. 12c) 1: a usu. raised structure or place on which sacrifices are offered or incense is burned in worship 2: a table on which the eucharistic elements are consecrated or which serves as a center of worship or ritual

altar boy n (1772): a boy who assists the celebrant in a liturgical service

altar call n (1946): an appeal by an evangelist to worshipers to come forward to signify their decision to commit their lives to Christ

altar of repose *often cap* A&R (ca. 1872): REPOSITORY 2

al-tar-piece 'ol-tār-pēs\ n (1644): a work of art that decorates the space above and behind an altar

altar rail n (1860): a railing in front of an altar separating the chancel from the body of the church

altar stone n (14c): a stone slab with a compartment containing the relics of martyrs that forms an essential part of a Roman Catholic altar

alt-az-i-muth 'al-tā-zī-mūth, 'tā-zā- n, *often attrib* [SV *altitudo* + *azimuth*] (1860): a telescope mounted so that it can swing horizontally and vertically; also: any of several other similarly mounted instruments

al-ter 'ol-tār\ v *al-tered*; *al-ter-ing* 'al-tā-rīng\ [ME, fr. MF *alterer*, fr. ML *alterare*, fr. L *alter* other (of two); akin to L *altus* other — more at *else*] (14c) 1: to make different without changing into something else 2: CASTRATE, SPAY ~ vi: to become different *syn* see CHANGE — **al-ter-abil-ity** 'ol-tār-ā-bīl-ē-tē\ n — **al-ter-able** 'ol-tār-ā-bəl\ adj — **al-ter-ably** 'ol-tār-ā-blē\ adv — **al-ter-er** 'ol-tār-er\ n

al-ter-a-tion 'ol-tār-ā-shən\ n (14c) 1: the act or process of altering: the state of being altered 2: the result of altering: MODIFICATION

al-ter-cate 'ol-tār-kāt\ vi *-cat-ed*; *-cat-ing* [L *altercatum*, pp. of *altercare*, fr. *alter*] (1530): to dispute angrily or noisily; WRANGLE

al-ter-ca-tion 'ol-tār-kā-shən\ n (14c): a noisy heated angry dispute; also: noisy controversy

alter ego 'ol-tār-ē-gō\ also *-ē-gō* n [L, lit., second I] (1537): a second self: as: a: a trusted friend b: the opposite side of a personality c: COUNTERPART 3

al-ter-nate 'US & Canad 'ol-tār-nat\ also 'al-; chiefly Brit 'ol-tār-adj [L *alternans*, pp. of *alternare*, fr. *alternus* alternate, fr. *alter*] (1513) 1: occurring or succeeding by turns (a day of ~ sunshine and rain) 2 a: arranged first on one side and then on the other at different levels or points along an axial line (~ leaves) — compare **OPPOSITE** b: arranged one above or alongside the other 3: every other: every second (he works on ~ days) 4: constituting an alternative (took the ~ route home) 5: ALTERNATIVE 3 — **al-ter-na-tive** 'ol-tār-nat-iv\ adv

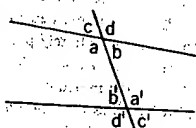
al-ter-nate 'ol-tār-nāt\ also 'al- v *-nat-ed*; *-nat-ing* vi (1599) 1: to perform by turns or in succession 2: to cause to alternate ~ vi: to change from one to another repeatedly (rain *alternated* with sun)

al-ter-nate 'same as 'al- (1717) 1: ALTERNATIVE 2: one that substitutes for or alternates with another

alternate angle n (1660): one of a pair of angles with different vertices and on opposite sides of a transversal at its intersection with two other lines: a: one of a pair of angles inside the two intersected lines — called also **alternate interior angle** b: one of a pair of angles outside the two intersected lines — called also **alternate exterior angle**

alternating current n (1839): an electric current that reverses its direction at regularly recurring intervals — abbr. AC

alternating group n (1904): a permutation group whose elements comprise those permutations of *n* objects which can be formed from the original order by



alternating interior angles a, a'; b, b'; alternate exterior angles c, c'; d, d'

alternating current n (1839): an electric current that reverses its direction at regularly recurring intervals — abbr. AC

alternating group n (1904): a permutation group whose elements comprise those permutations of *n* objects which can be formed from the original order by

making consecutively an even number of interchanges of pairs of objects

alternating series n (ca. 1909): a mathematical series in which the terms are alternatively positive and negative

al-ter-na-tion 'ol-tār-nā-shən\ also 'al- n (15c) 1 a: the act or process of alternating or causing to alternate b: alternating occurrence 2: INCLUSIVE DISJUNCTION 3: the occurrence of different forms

alternation of generations (1858): the occurrence of two forms differently produced in the life cycle of a plant of animal involving the regular alternation of a sexual with an asexual generation

al-ter-na-tive 'ol-tār-nā-tiv, 'al-adv (1540) 1: ALTERNATIVE 2: offering or expressing a choice (several ~ plans) 3: different from usual or conventional: as: a: existing or functioning outside established cultural, social, or economic system (~ newspaper styles) b: of, relating to, or being rock music that is regarded as alternative to conventional rock and is typically influenced by rock, hard rock, hip-hop, or folk music — **al-ter-na-tive-ly** 'al-tār-nā-tiv-ē\ adv

alternative n (1624) 1 a: a proposition or situation offering a choice between two or more things only one of which may be chosen b: opportunity for deciding between two or more courses of procedure 2 a: one of two or more things, courses, or propositions to be chosen b: something which can be chosen instead (the only ~ to taxation) *syn* see CHOICE

alternative medicine n (1977): any of various systems of treating disease (as chiropractic, homeopathy, or faith healing) included in the traditional medical curricula taught in the U.S. and abroad

alternative school n (1972): an elementary or secondary school with a nontraditional curriculum

al-ter-na-tor 'ol-tār-nā-tōr\ also 'al- n (1892): an electric generator producing alternating current

alt-horn 'alt-hōrn\ n [G, fr. *alt* alto + *Horn* horn] (1859): an alto horn

al-though also **al-tho** 'ol-t'hō\ conj [ME *although*, fr. *al* all + *though*] (14c): in spite of the fact that: even though

al-time-eter 'al-tī-mē-tēr, 'al-tō-mē-tēr\ n [L *altus* + E *-meter*] (ca. 1828): an instrument for measuring altitude; esp.: an aneroid barometer designed to register changes in atmospheric pressure accompanying changes in altitude — **al-time-etry** 'al-tī-mē-trē\ n

al-ti-pla-no 'al-tī-plā-nō\ n, pl *-nos* [AmerSp, fr. L *altus* + *planum* plain] (1919): a high plateau or plain: TABLELAND

al-ti-tude 'al-tī-tūd\ also 'tī-tūd\ n [ME, fr. L *altitudo* height, depth, in *altus* high, deep — more at *old*] (14c) 1 a: the angular elevation of a celestial object above the horizon b: the vertical elevation of an object above a surface (as sea level or land) of a planet or natural satellite c (1): a perpendicular line segment from a vertex of a geometric figure (as a triangle or a pyramid) to the opposite side or the opposite side extended (2): the length of an altitude 2: a high level (as of quality or feeling) (the ~ of his anger) 3 a: vertical distance of an object from a point of reference b: position at a height c: an elevated region: EMINENCE

al-ti-tu-dinal 'al-tī-tū-dī-nāl\ adj — **al-ti-tu-dinally** 'al-tī-tū-dī-nālē\ adv

altitude sickness n (1920): the effects (as nosebleed or nausea) of oxygen deficiency in the blood and tissues developed in rarefied air at high altitudes

al-to 'al-tō\ n, pl *altos* [It, lit., high, fr. L *altus*] (ca. 1724): 1: COUNTERTENOR 2: CONTRALTO 2: the second highest voice part in a 4-part chorus 3: a member of a family of instruments having a range lower than that of the treble or soprano; esp.: an alto saxophone

alto adj (ca. 1724): relating to or having the range or part of an alto

al-to-cu-mu-lus 'al-tō-kū-mū-ləs\ n, pl *-li* [NL, fr. L *altus* NL *o* + *cumulus*] (1894): a fleecy cloud formation consisting of large whitish globular cloudlets with shaded portions — see **CLOUD** illustration

al-to-gether 'ol-tō-ge-thēr\ adv [ME *altogedere*, fr. *al* all + *togedere* together] (13c) 1: WHOLLY, COMPLETELY (an ~ different problem) 2: in all: ALL TOLD (spent a hundred dollars ~) 3: on the whole

altogether n (1894): NUDE — used with the (posed in the ~)

al-to-rel-ievo or **al-to-ri-lev-vo** 'al-tō-rē-lē-vō, 'al-tō-rē-lē-vō\ n, pl *altos-relievos* or *al-to-ri-lev-vo* [L, fr. *altus* high + *relievo* relief] (1664) 1: HIGH RELIEF 2: a sculpture in high relief

al-to-stratus 'al-tō-strā-təs, 'strā- n, pl *-ti* [NL, fr. L *altus* + *stratus*] (1894): a cloud formation similar to cirrostratus but darker and at a lower level — see **CLOUD** illustration

al-tri-cial 'al-trī-shəl\ adj [L *altrix*, *altrix*, fem. of *altor* one who nourishes, fr. *alere* to nourish — more at *old*] (1872): being hatched or born or having young that are hatched or born in a very immature and helpless condition so as to require care for some time (~ birds) — compare **PRECOCIAL**

al-tru-ism 'al-trū-iz-m\ [F *altruisme*, fr. *autrui* other people, fr. OF *oblique* case form of *autre* other, fr. L *alter*] (1853) 1: unselfish regard for or devotion to the welfare of others 2: behavior by an animal that is not beneficial to or may be harmful to itself but that benefits others of its species — **al-tru-ist** 'al-trū-ist\ n — **al-tru-istic** 'al-trū-ist-ik\ adj — **al-tru-is-ti-cal-ly** 'al-trū-ist-ik-lē\ adv

al-u-la 'al-yū-lə\ n, pl *-lae* 'lē, 'lā\ [NL, fr. L, dim. of *ala* wing — more at *aisle*] (1772): the process of a bird's wing corresponding to the thumb and bearing a few short quills — called also **bastard wing**

al-um 'al-əm\ n [ME, fr. MF *alum*, *alun*, fr. L *alumen*] (14c) 1: a potassium aluminum sulfate NH4Al(SO4)2.12H2O or an ammonium aluminum sulfate NH4Al(SO4)2.12H2O used esp. as an emetic and as an antacid 2: any of various double salts isomorphous with aluminum sulfate 3: ALUMINUM SULFATE

al-um-i-ni-a 'al-yū-mī-nē-ə\ n [NL, fr. L *alumin*, *alumen* alum] (1801): the oxide of aluminum Al2O3 occurring native as corundum and in hydrated forms (as in bauxite)

al-u-min-i-ate 'al-yū-mī-nē-āt\ n (1841): a compound of alumina with a metallic oxide

al-u-min-i-um 'al-yū-mī-nē-əm\ n [NL, fr. *alumina*] (1812) chiefly Brit: ALUMINUM

EXHIBIT

tabbies

A